

Science and the Connecticut Shoreline: Storm Hazards and Marine Pollution



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ABSTRACT

Living with the Connecticut shoreline involves the impacts of the environment on human development as well as the impacts of human activities on the environment. Although many New Englanders are not aware of it, the region has a history of devastating hurricanes that extends back into the 1600's. The hurricane of 1938 was the most damaging storm in U.S. history until Andrew in 1989. The state also has a long history of industrialization. In the first quarter of the 20th century, the city of New Haven had approximately 500 factories, most situated along the shoreline or along watercourses that led to New Haven harbor. Students in our SENCER class investigate both of these phenomena. Using surveying methods, they map potential flood zones for a repeat of the 1938 storm and estimate resulting economic and environmental damages. Later in the semester, students take harbor sediment samples from a research vessel. Using atomic absorption spectrophotometry, they determine copper concentrations in the sediments, map the distribution of copper, and estimate the toxicity to benthic organisms. Results are written up in the form of scientific papers. Included in the papers are recommendations for storm preparedness and remediation of heavy metal pollutants in the harbor.

COURSE GOALS

Our emphasis is on giving students an exposure to science and societal issues related to the coast by actually having students *do science* with meaningful results. This course is designed to teach science by pursuing the following goals:

- 1) Do science using scientific methodology,
- 2) Emphasize field experience and data collection,
- 3) Conduct quantitative analyses,
- 4) Write for clarification of thinking and communication of ideas, and
- 5) Stress the societal relevance of scientific investigation.



Honors College students participate in the annual Beach Cleanup at West Haven, CT. The cleanup is held on a Saturday in September as part of National Beach Week and is sponsored in CT by the Save the Sound.

LEARNER OUTCOMES

On completion of this course, students will be able to:

Use the scientific method to examine questions concerning their observations of the coastal environment, including the formulation of testable hypotheses and the collection of field and laboratory data to evaluate their hypotheses,

Recognize and discuss the unique aspects (geological, biological, and chemical) of inland and coastal habitats including sandy beaches, salt marshes and coastal dunes,

Identify and quantify specific sources, fates and impacts of pollutants (primarily metals and floatable debris) entering coastal waters, and

Identify the causes and consequences of global climate change, including the social, economic and environmental impacts due to hypothesized increased storminess and coastal flooding.



In the marsh, students identify grasses and invertebrates and delineate vegetative zones.



Students conduct a street survey to determine changes in elevation away from the coast as part of a study to examine the possible impact of coastal flooding due to a hurricane with an intensity similar to the Hurricane of 1938. Students note the structures and ecosystems at each elevation to assess possible damage.

Coastal Processes Module

Coastal Processes and Environments of Long Island Sound (Habitats and Storms)

Tidal Wetlands: Physical Processes and Ecology
Field Trip – West Haven marsh

Beaches and Dunes Field Trip – Hammonasset State Beach

Living with the Coast: Storms and Coastal Erosion
Lab Activity – Topographic Surveys

Review/Data Processing/Report writing
Field Trip – Storm Surge Surveys

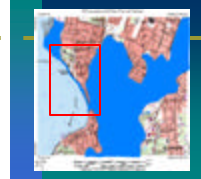
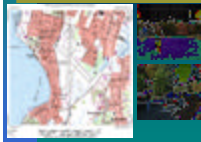


Here students examine the Branford Geis, a collision terrane associated with the assembly of Pangaea.



Observations on the beach include sand grain size, profile of the beach and the collection of invertebrates.

Hurricane Impacts – Coastal Flooding



Topographic map showing the study area at Morris Cove in New Haven, CT. Students mapped the flood zone boundaries of the 1938 hurricane based on storm tide elevations recorded at the time of the storm. Results indicate that the greatest danger to coastal homes is inundation from the airport area to the east. The red box indicates the area where the street surveys were focused.

Coastal Pollution Module

New Haven Harbor (Social, Science and Economics)

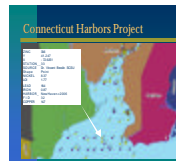
New Haven Harbor – History, Economic Importance.
Field Trip – New Haven Colony Historical Society

Field Trip – Harbor Cruise (R/V Island Rover)
Sample sediments, organism and water collection

Harbor Pollution – Sources and Solutions
Lab Activity Prepare sediment for copper analysis, sediment classification.

Marine Pollution
Lab Activity – Sediment analysis for copper

Sediment copper contamination is mapped using GIS software and is accessible from the CT harbors website.



<http://www.southernct.edu/departments/ccms/ctharborhome.html>



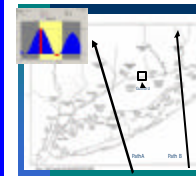
Students examine the historical industrial development of New Haven, CT and use maps and locations of known sources of contaminants to select sampling sites. Students are required to develop hypotheses concerning the sediment type and extent of metal contamination at each site selected.



Students retrieve the sediment sample grab from New Haven harbor for processing about the R/V Island Rover

Final Exam—Hypothetical Case Study

The National Weather Service (NWS) this morning has issued a hurricane storm warning for the entire state of Connecticut for Wednesday, July 30, 2008. The NWS has been tracking hurricane Teresee for the past three days in the tropical Atlantic east of Cuba. The Hurricane is currently a Category 4 storm according to the Saffir-Simpson Scale with sustained winds exceeding 140 mph. The NWS anticipates that the storm will begin to travel north offshore along the US east coast reaching New England by Friday morning, July 30th. The NWS has identified the two most likely storm paths shown in Figure 1. Storm path A brings the eye of the storm over Bridgeport, CT and storm path B brings the eye of the storm over New London, CT.



Please outline the best and worst case scenarios for Dr. Tait's house and Dr. Breslin's oyster beds concerning the potential damage to these properties due to storm paths A and B.

Student Perspectives: An End of the Course Survey

What did you learn from the hands-on aspects of the course?

- Deeper understanding of the material in the course (n=7)
- What researchers in the field do and how they make their choices (n=2)
- How to collect different kinds of samples or data in the field (n=2)
- "To take the course a series of consequences. "You don't really understand what it means to 'take' and 'make' data. 'Make' means that you've added through a margin and ruined your samples. That did work better."

How was this course similar to or different from previous science courses you have taken?

- Simulations
- Lectures, labs, Power/Point presentations (n=4)
- Differences:
 - Field trips and data collection in the field (n=4)
 - Emphasis on relevance and local subject matter made data more interesting (n=1)
 - Emphasis on doing research and writing papers (n=1)
 - "I see much more meaning to learn about something that affects the world around me. Before, I was just doing something I had to know about in the future like all these assignments I do."

Why do you think there was so much emphasis on getting it right in this course?

- Without accurate data, the results of a scientific study are meaningless (n=2)
- Because the investigators the class undertook have multiple factors (n=2)
- Because scientific results are very rigorous (n=4)
- "It felt like I was away from the course actually knowing the material (n=4)"
- "My physics and other classes got me the data right, but I was never become involved in my brain. Being detailed and getting it right has pushed me with tools to make a difference in the future."

What do scientists do?

- Understand the past, present and future of many aspects of the world by careful observation and analysis (n=6)
- Formulate and test hypotheses by gathering data and analyzing it (n=4)
- Solve problems (n=4)
- Study the interactions of humans and the environment (n=2)
- Create models of how the world operates (n=2)
- "Wear matching shirts, for starters..."

What Have We Learned?

SENCER courses require clear goals

Prioritize information—targeted lectures (Know your audience)

Provide more assistance with quantitative tasks

Revision is very important—emphasize "getting the story right"

Reinforce process and outcomes

Course has contributed to our understanding of harbor contamination and preparedness for storms